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Yearly Trend of a Mountain Pine Beetle Infestation near Spring Creek Park Bridger-Teton National Forest

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INTRODUCTION

This is a report on a study to measure the yearly trend of a mountain pine beetle, Dendroctonus ponderosae Hopkins, outbreak in a high-elevation lodgepole pine stand on the Bridger-Teton National Forest, Wyoming. This study was patterned after an earlier established trend study in Yellowstone National Park (Parker, 1973). In the Yellowstone study area (6,400 feet), the epidemic lasted seven years, peak tree killing occurred the fourth year, and cumulative mortality amounted to 55 trees per acre or 26 percent of the stand 5 inches dbh and larger. More small trees were killed than large ones, but in proportion to their occurrence, the larger trees were killed early and at a higher rate. Since these data were relevant only to this area and perhaps to other similar stands, this study was initiated in 1970 to collect similar type data in a stand with altogether different stand characteristics. The major differences being elevation, stand composition, and stand structure.

The study area is located on the West Slope of the Wind River Range near Spring Creek Park, Bridger-Teton National Forest, Wyoming (Figure 1 and 2). The survey area consists of approximately 400 acres of lodgepole pine type at an average elevation of 9,200 feet.

The West Slope of the Wind River Range has a long history of mountain pine beetle-caused mortality in lodgepole pine. The current outbreak began during the early 1960's. Small groups of "faders" were first observed during aerial surveys in the low elevation fringe-type stands. Beetle populations intensified at the low elevations and spread into susceptible stands at higher elevations.

This study was initiated in the spring of 1970 after some tree killing had begun in the survey area. The objective of this study was to measure yearly mortality during the life of the infestation. To avoid problems associated with post dating previous mortality, trees killed prior to 1968 were not separated by year of attack.

1/ Formerly the Bridger National Forest.

Consequently, the trend during the very formative years is not known. However, mortality was recorded in the area during aerial surveys as early as 1966.

METHODS

During the spring of 1970, 85 permanent variable plots were established in a systematic grid pattern at seven-chain intervals. Mountain pine beetle-caused mortality was recorded on each plot using a BAF of 5. Trees were tallied in one of three categories: currently infested (1969 attacks), "faders" (1968 attacks), and previous mortality (1967 and before). In addition, during the initial cruise, green stand data were recorded on every other plot (BAF-10, 26 plots). All trees were recorded by 2-inch diameter class and only trees greater than 5.5 inches dbh were tallied. Each fall following the initial cruise, surveys were conducted to record new attacks and to correct errors made the previous year. The most common mistakes were recording strip attacks as mortality. Occasionally new attacks were overlooked; these were recorded the following year.

RESULTS AND DISCUSSION

Green stand structure prior to the bark beetle outbreak was reconstructed using green stand mortality data from the original cruise. The stand was predominately lodgepole pine (84 percent) with somellimber pine (8 percent), Douglas-fir (6 percent), and lesser amounts of Engelmann spruce (1.5 percent) and subalpine fir (0.5 percent) (Table 1). Of the 240.9 host trees per acre, cumulative mortality was 25.9 trees per acre or 9.9 percent of the stand. Lodgepole pine mortality in trees per acre was 5.98 prior to 1968, 2.03 in 1968, 4.41 in 1969, 6.62 in 1970, 3.10 in 1971, 0.96 in 1972 and 0.25 in 1973 representing a cumulative loss of 23.35 trees per acre (Table 2 and Figure 3). Limber pine mortality was 0.09 prior to 1968, 0.85 in 1968, 0.75 in 1969, 0.60 in 1970, 0.25 in 1971, and zero in 1972 and 1973 for a cumulative loss of 2.54 trees per acre (Table 3). Peak tree killing of limber pine occurred in 1968 while lodgepole experienced its heaviest loss during 1970. A statistical analysis of between plot variation for green stand and mortality is summarized in Table 4.

CONCLUSIONS

Since mortality was recorded each year, except during the initial buildup, the inherent personal error involved in post dating mortality based on foliar and bark characteristics was eliminated. In fact, errors made during one cruise were corrected the following year. This system provided mortality data based on those trees which actually died during a given year.

During the life of the infestation, 9.9 percent of all trees larger than 5 inches dbh were killed by the mountain pine beetle. Even though Spring Creek Park had 5 times as many trees larger than 13 inches dbh as did Yellowstone Park, cumulative mortality was 9.9 percent compared to 26.3 percent in Yellowstone. Spring Creek Park had an abundance of large trees, but losses were less than one-third of those recorded in Yellowstone. This disparity is primarily due to a 2,800 foot difference in elevation. This reduction in mortality with elevation agrees with the inverse relationship between beetle-caused mortality and elevation reported by Amman and others (1973).

REFERENCE CITES

Amman, G. D., B. H. Baker, and L. E. Stipe. 1973. Lodgepole pine losses to mountain pine beetle related to elevation. USDA Forest Serv. Res. Note INT-171, 8 p.

Parker, D. L. 1973. Trend of a mountain pine beetle outbreak. J. Forest. 71(11): 668-670.

APPENDIX

Figure 2. Oblique aerial photograph taken in 1969 of the study area near Spring Creek Park, Bridger-Teton National Forest, Wyoming.

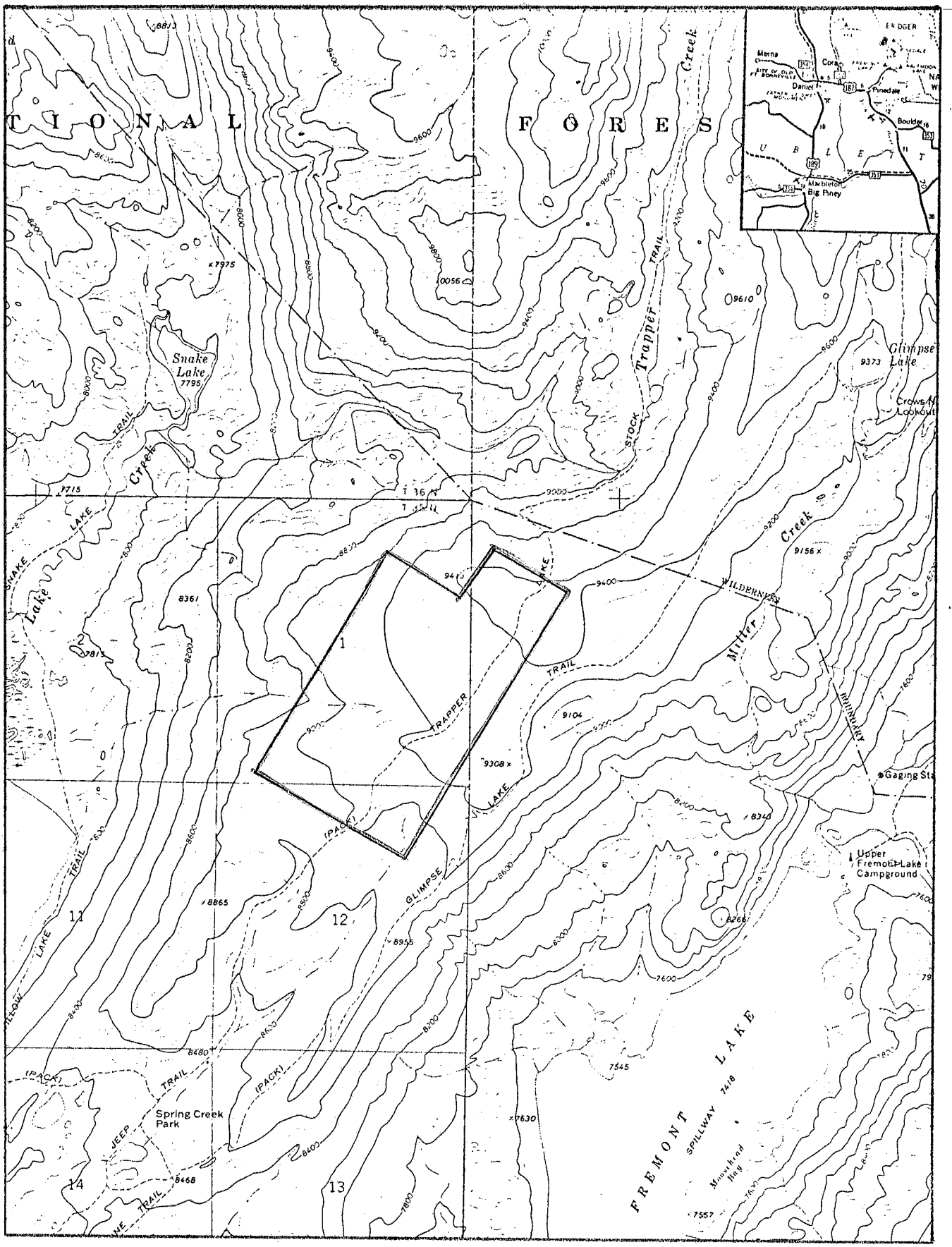

Figure 1. Location of study area near Spring Creek Park, Bridger-Teton National Forest, Wyoming.

Table 1. Reconstructed green stand structure in the survey area near Spring Creek Park, Bridger-Teton National Forest, Wyoming.

	Green Stems/Acre Diameter Classes								
	6	8	10	12	14	16	16	Total	Percent of Stand
Lodgepole pine	33.60	49.92	39.48	40.82	29.81	15.32	10.91	219.86	84.0
Limber pine	--	8.22	5.75	2.49	1.67	1.42	1.58	21.13	8.1
TOTAL HOST	33.60	58.14	45.23	43.31	31.48	16.74	12.49	240.99	92.1
Douglas-fir	9.79	1.10	3.53	--	0.72	--	0.22	15.36	5.9
Subalpine	--	--	0.71	--	0.36	--	--	1.07	0.4
Engelmann spruce	1.96	1.10	--	--	0.36	--	0.87	4.29	1.6
TOTAL NONHOST	11.75	2.20	4.24	--	1.44	--	1.09	20.72	7.9
TOTAL STAND	45.35	60.34	49.47	43.31	32.92	16.74	13.58	261.71	100.00

Table 2. Mountain pine beetle caused mortality of lodgepole pine by year and diameter class near Spring Creek Park, Bridger-Teton National Forest, Wyoming.

	Dead Lodgepole Pine/Acre Diameter Class								
Year	6	8	10	12	14	16	16	Total	Cumulative Mortality
1967 & before	0.30	0.34	0.97	1.20	1.10	1.10	0.97	5.98	5.98 (2.7%)
1968	--	--	0.11	0.60	0.44	0.38	0.50	2.03	8.01 (3.6%)
1969	--	--	0.32	0.82	1.65	0.89	0.73	4.41	12.42 (5.6%)
1970	--	0.17	0.43	1.57	1.71	1.31	1.43	6.62	19.04 (8.7%)
1971	--	--	0.32	1.05	0.77	0.46	0.50	3.10	22.14 (10.1%)
1972	--	--	0.22	0.08	0.22	0.21	0.23	0.96	23.10 (10.5%)
1973	--	--	--	0.08	0.06	0.08	0.03	0.25	23.35 (10.6%)
Total	0.30	0.51	2.37	5.40	5.95	4.43	4.39	23.35	

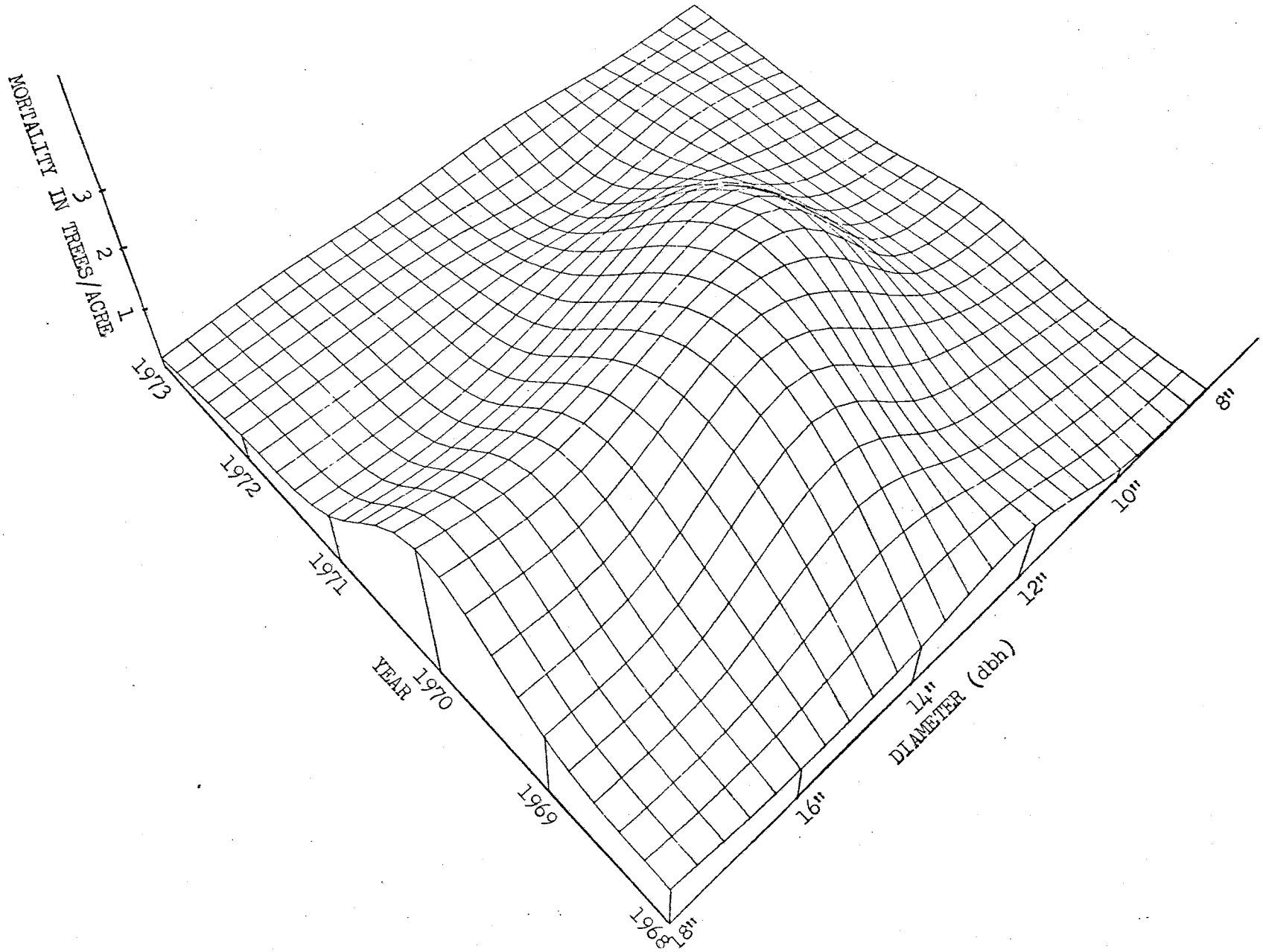

Figure 3. Three-dimensional representation of lodgepole pine mortality during an epidemic near Spring Creek Park, Bridger-Teton National Forest, Wyoming.

Table 3. Mountain pine beetle caused mortality of limber pine by year and diameter class near Spring Creek Park, Bridger-Teton National Forest, Wyoming.

	Dead Limber Pine/Acre Diameter Class								
Year	6	8	10	12	14	16	16	Total	Cumulative Mortality
1967 & before	--	--	--	--	0.06	--	0.03	0.09	0.09 (0.4%)
1968	--	0.51	--	0.23	--	0.04	0.07	0.85	0.94 (4.4%)
1969	--	--	0.11	0.30	0.17	--	0.17	0.75	1.96 (8.0%)
1970	--	--	0.11	--	0.11	0.21	0.17	0.60	2.29 (10.8%)
1971	--	--	0.22	--	--	--	0.03	0.25	2.54 (12.0%)
1972	--	--	--	--	--	--	--	--	2.54 (12.0%)
1973	--	--	--	--	--	--	--	--	2.54 (12.0%)
Total	--	0.51	0.44	0.53	0.34	0.25	0.47	2.54	

Table 4. Summary of statistical analyses of between plot variation for the number of trees per acre for green stand and mortality near Spring Creek Park, Bridger-Teton National Forest, Wyoming.

Green Stand[a]	Mean[b]	Standard Deviation	Standard Error
Lodgepole pine	207.4	157.5	30.8
Limber pine	19.4	38.1	7.5
Nonhost species	20.7	33.9	6.6
Total Green	247.6	169.0	33.1
Lodgepole pine mortality[c]			
1967	6.0	11.6	1.3
1968	2.0	5.2	0.6
1969	4.4	10.9	1.2
1970	6.6	15.3	1.6
1971	3.1	7.7	0.8
1972	0.9	3.8	0.4
1973	0.2	1.2	0.1
Limber pine mortality[c]			
1967	0.1	0.6	0.1
1978	0 0.8	7.3	0.8
1969	0.7	4.8	0.5
1970	0.6	3.1	0.3
1971	0.2	2.0	0.2
1972	0	-	-
1973	0	-	-

[a] Based on 26 green stand plots and represents green stand in Spring 1979.

[b] Numbers have been rounded.

[c] Based on 85 mortality plots.